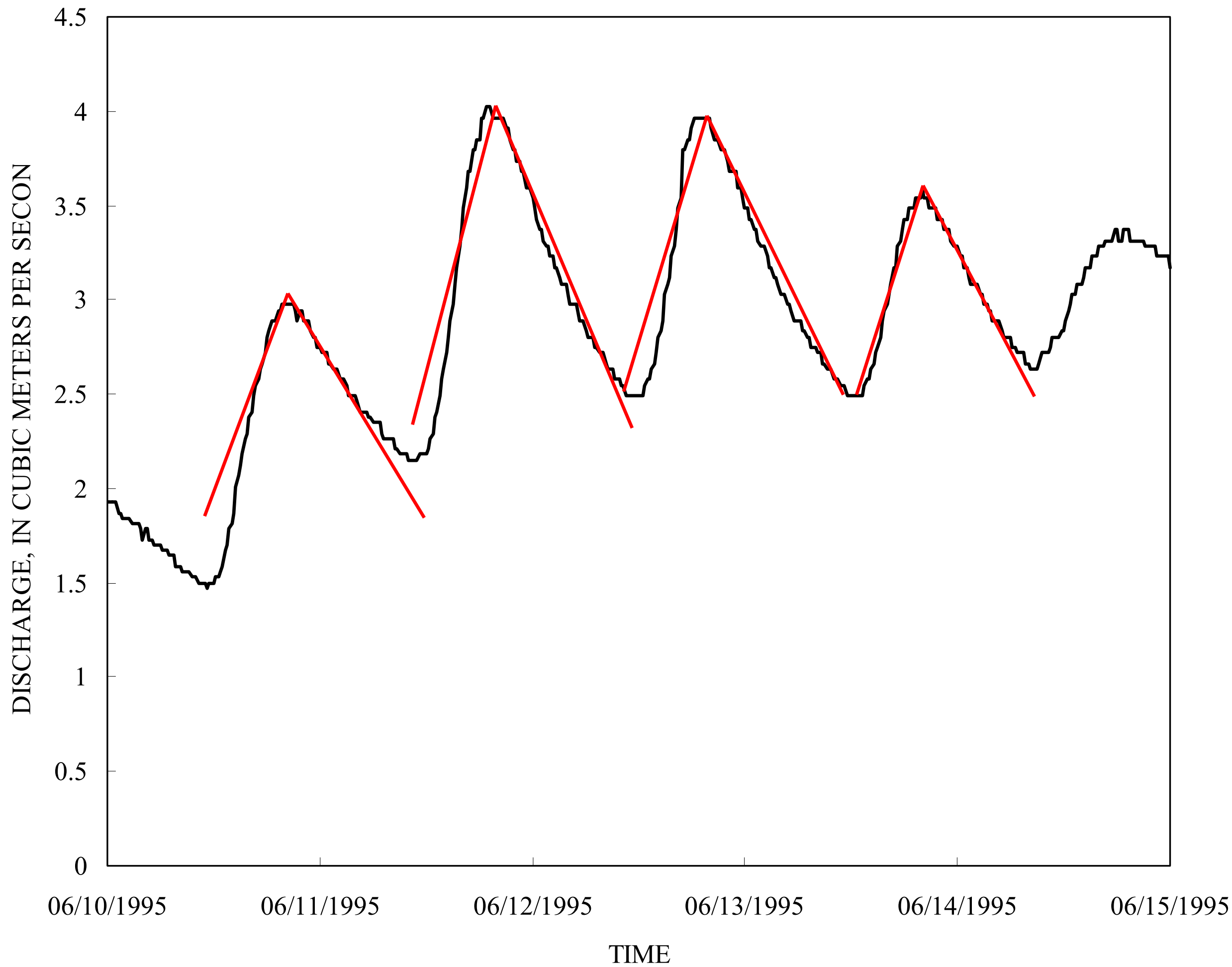

Figure 5-31. Hydrograph shape of typical snowmelt runoff events. NRCS (1996) triangular hydrograph (red line) is superimposed on the measured discharge record. Discharge data is from USGS gaging station 10336674 on Ward Creek.

Ward Creek

Modeling Reach. The modeling reach of Ward Creek extends from the mouth of the channel (river km 0.09) to river km 5.80 (Figure 5-30). The water and sediment loadings into the modeling reach are provided by the watershed model AnnAGNPS. The modeling reach is composed of 17 cross sections (Figure 5-30). These cross sections are hereafter referred to as cross sections "1" through "17," where "1" is the most upstream cross section and "17" is the most downstream cross section. These cross sections were surveyed during the data collection campaign in the fall of 2002 (see section 2.2).

Physical Properties. Roughness values were assigned to bed, bank, and floodplain sections of each cross section based on visual inspection of the channel and following guidelines set forth by Aldridge and Garrett (1973) and Jarrett (1985). Bed- and bank-material composition and properties at each cross section were provided by local sediment samples and BST tests (section 2.3). Ward Creek streambanks, on average, have the highest measured silt/clay content of those streams sampled, 17%. In case these data were locally unavailable, data collected at the nearest similar site were used. Table G-3 in the appendix lists the data used at each cross section.

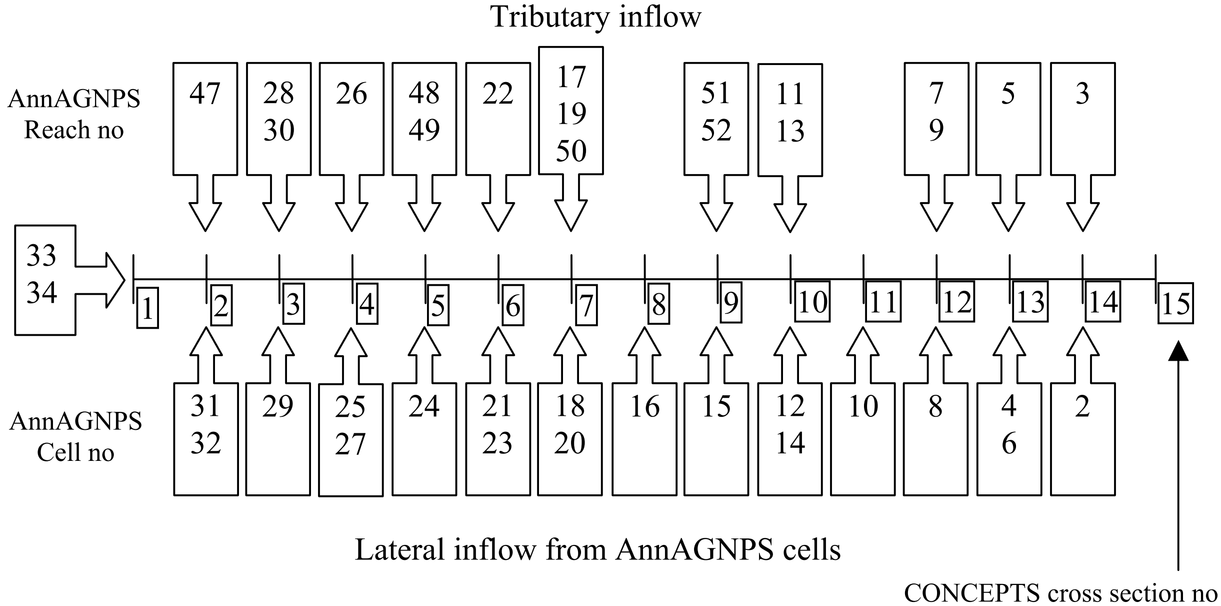

Figure 5-32. Linkage between AnnAGNPS reaches and cells (Figure 5-8) and CONCEPTS cross sections for General Creek. (The last digit of the cell ID (a 2 or a 3) is omitted.)

5.3.2 Tributary and Lateral Inflow

AnnAGNPS provides peak flow discharge (m^3/s), runoff volume (m^3), and clay, silt, and sand mass (T) for each runoff event for reaches and cells draining into the modeling reach. These data are then converted into triangular-shaped hydrographs (NRCS, 1986). The duration of the hydrograph is calculated as twice the runoff volume in m^3 divided by the peak discharge. The time-to-peak occurs at 37.5% of the hydrograph duration. The shape of the hydrograph and the value of time-to-peak agree well with that observed for snowmelt events in the Lake Tahoe basin (Figure 5-31).

The linkage between AnnAGNPS cells and reaches and CONCEPTS cross sections is shown in Figure 5-32 for the modeling reach along General Creek, Figure 5-33 for the Upper Truckee River, and Figure 5-34 for Ward Creek. The AnnAGNPS reach and cell IDs in these figures are those of AnnAGNPS subareas. The subarea ID can be obtained from the reach or cell ID by omitting the last digit of the latter ID (a 1, 2, 3, or 4). The reach and cell IDs for General Creek, Upper Truckee River, and Ward Creek are shown in Figures 5-8, 5-14, and 5-18, respectively.

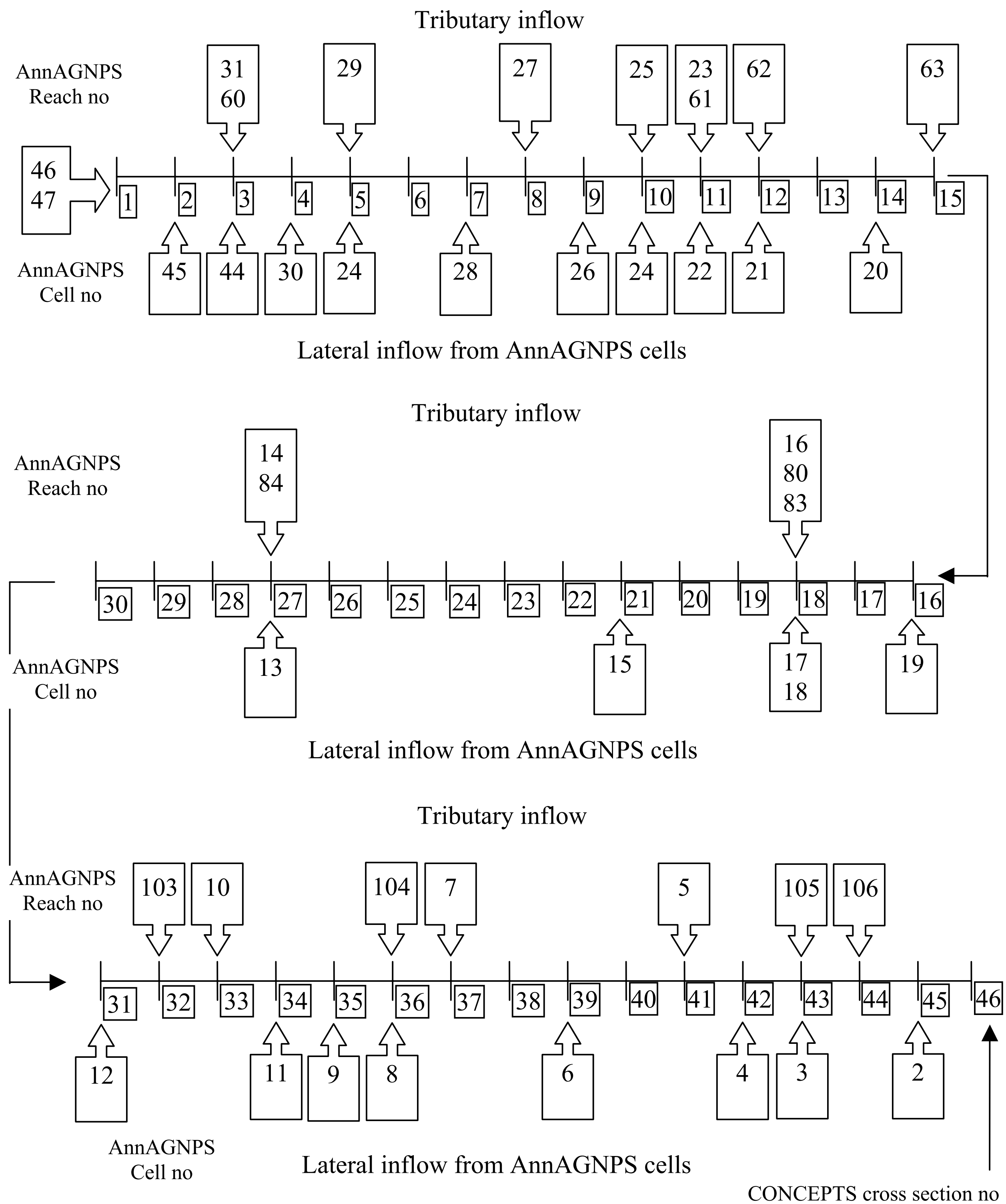

Figure 5-33. Linkage between AnnAGNPS reaches and cells (Figure 5-14) and CONCEPTS cross sections for the Upper Truckee River. (The last digit of the cell ID (a 2 or a 3) is omitted.)

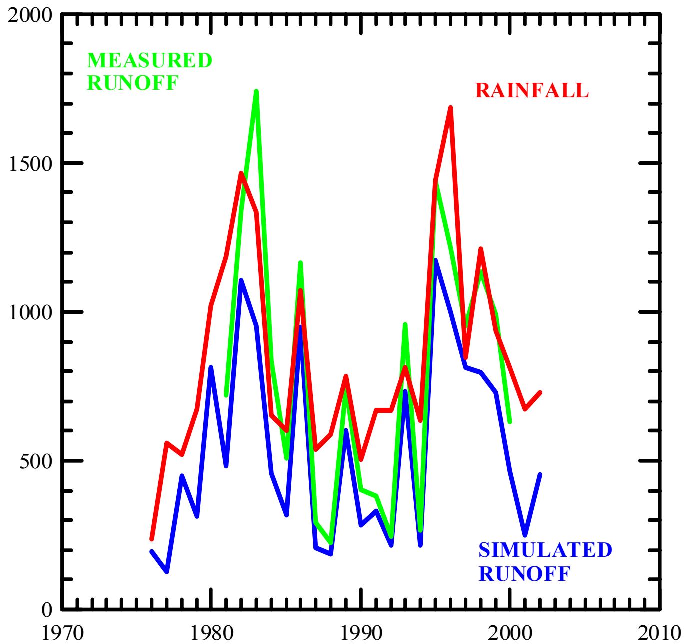

Figure 5-35. AnnAGNPS simulated and measured yearly runoff at the USGS gaging station 10336645 and the yearly precipitation from the Tahoe City climate station used within the simulation of the General Creek watershed.

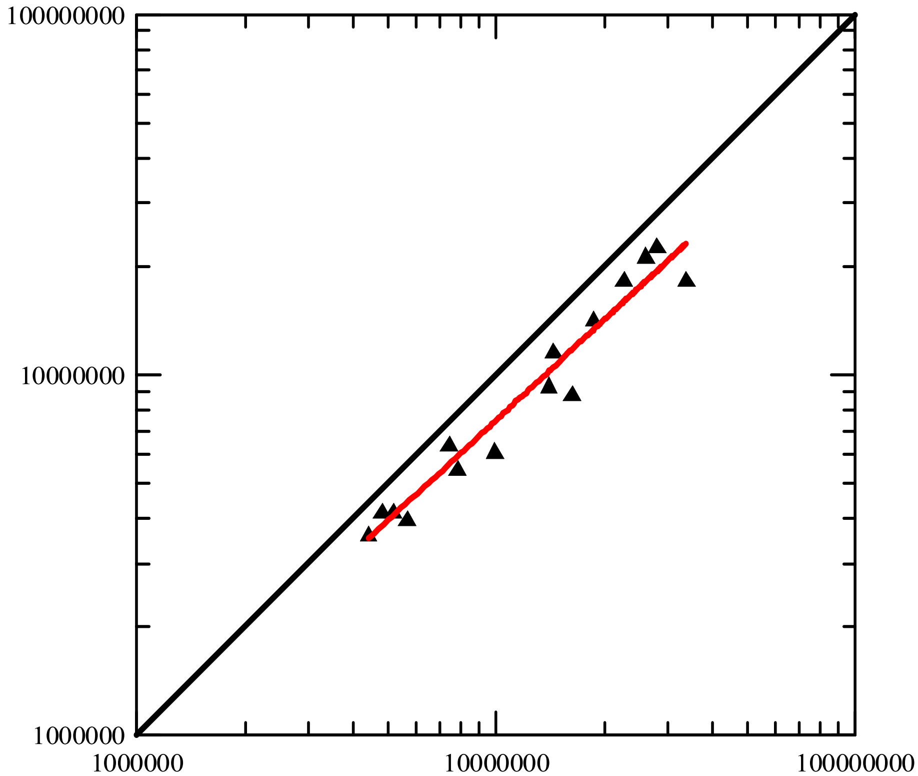

Figure 5-36. AnnAGNPS simulated versus measured yearly runoff from 1981-2000 at station 10336645, General Creek watershed.

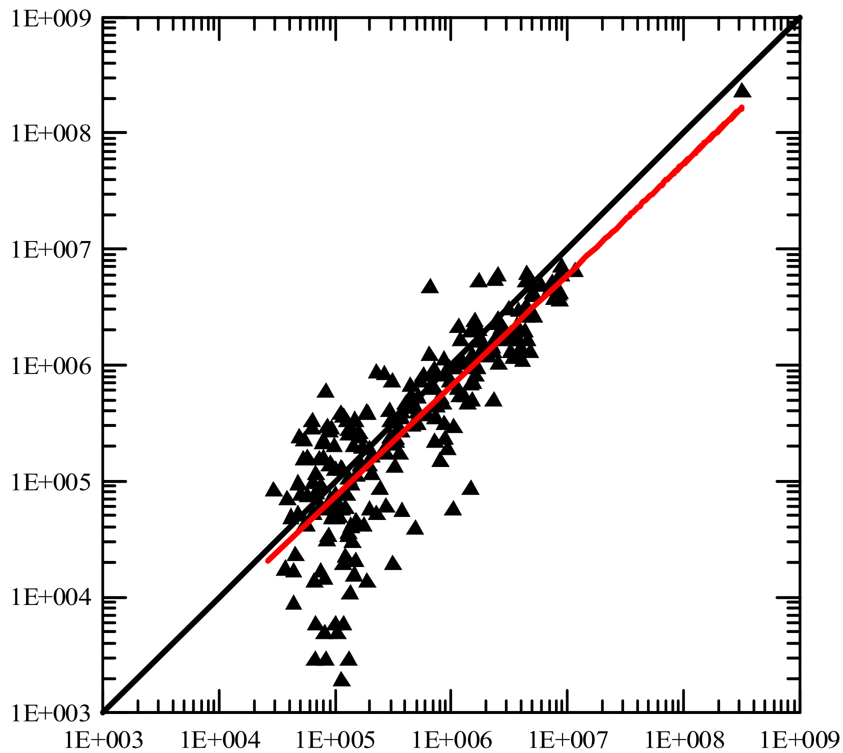

Figure 5-37. AnnAGNPS simulated versus measured monthly runoff during 1981-2000 at the station 10336645, General Creek watershed.

Monthly Runoff. Simulated monthly runoff was compared with measured data for all months from 1981 t -2000 at station 10336645 (Figure 5-37). The trend of simulated monthly runoff matched the measured data very well indicating that the modification made to the lapse rate (Figure 5-24) was appropriate for matching the timing of snowmelt peaks. Since precipitation occurred mainly as snowfall, it is critical that snowmelt be accurately reflected so that channel erosion could be adequately simulated by CONCEPTS.

Annual Fine-Sediment Loads. Simulated, annual fine-sediment loads were compared to calculated annual values at station 10336645 from 1981 to 2001 (Figure 5-38). Simulated fine-sediment transport compared relatively well with data from the gaging station in low- and moderate-flow years. For high flow and sediment- producing years such as 1983 and 1997 where AnnAGNPS results are low relative to the calculated values at the gage, the bulk of the sediment may be coming from channel sources. The application of CONCEPTS will show considerable improvement in the comparison with measured values.

Monthly Fine-Sediment Loads. Monthly, simulated fine-sediment loads were compared with data from station #0336645 for the period 1981 to 2001 (Figure 5-39). General temporal variability of the simulated fine-sediment loads matched the measured reasonably well indicating that upland sources of fine sediment may be an important contributor in the General Creek watershed. Fine-sediment loads simulated by AnnAGNPS from upland sources were less than the calculated values at the gage. This is to be expected because fine sediments emanating from channel sources are neglected here and will be simulated by CONCEPTS.

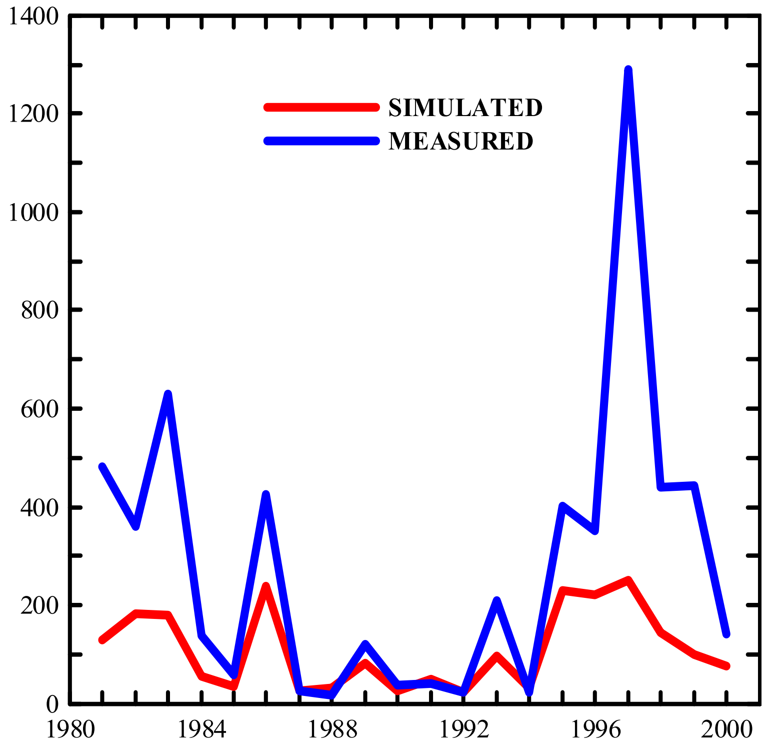

Figure 5-38. AnnAGNPS simulated and measured yearly sediment at station 10336645, General Creek watershed.

Sources. The simulated runoff by AnnAGNPS cells can be used to describe the degree of runoff from the various cells within the watershed (Figure 5-40). A significant amount of runoff occurs in the upper end of the watershed where the landuse is rock outcrop. The erosion that occurred within each AnnAGNPS cell can also show the spatial variability throughout the watershed (Figure 5-41). The fine sediment yield that reaches the edge of each AnnAGNPS cell also shows considerable variability throughout the watershed (Figure 5-42) For the most part, monthly fine-sediment loadings do plot around the line of perfect agreement in Figure 5-39, providing further evidence that upland sources may provide the majority of the fine sediment to the downstream gage.

Recurrence Interval for the Annual Maximum Instantaneous Peak Discharge. A comparison of measured and simulated peak discharges for water years 1981 – 2001 is shown in Table 5-5. Simulated peaks listed as CONCEPTS represent runoff values input from AnnAGNPS into CONCEPTS and then routed downstream by the channel-evolution model. Generally, the calculated annual peak discharge is 30 to 50 percent larger than those observed. The simulated peak discharge on January 2, 1997 is twice as large as that observed. The 2-year, 5-year, 10-year, and 20-year peak discharges calculated from the observed annual peaks are 6.1, 11.7, 16.5, and 21.9 m^3/s, respectively. The corresponding peak discharges computed by: 1) AnnAGNPS are 8.0, 15.0, 21.8, and 30.5 m^3/s, respectively; and 2) CONCEPTS are 8.4, 15.9, 23.6, and 33.9 m^3/s, respectively.

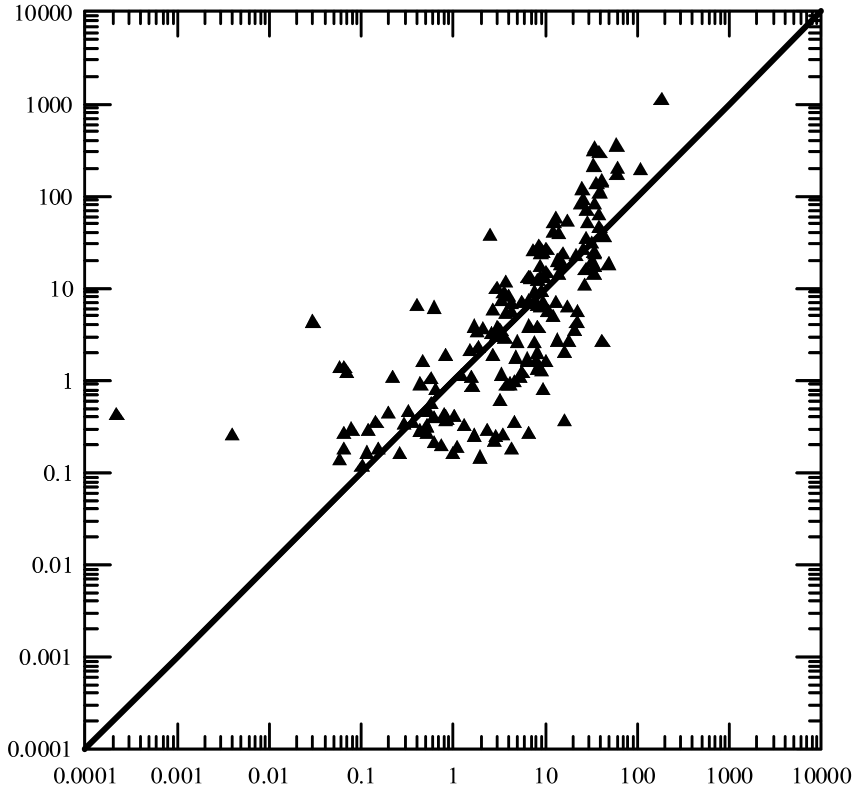

Figure 5-39. AnnAGNPS simulated versus measured monthly fine sediment during 1981-2000 at the USGS gaging station 10336645 at General Creek watershed.

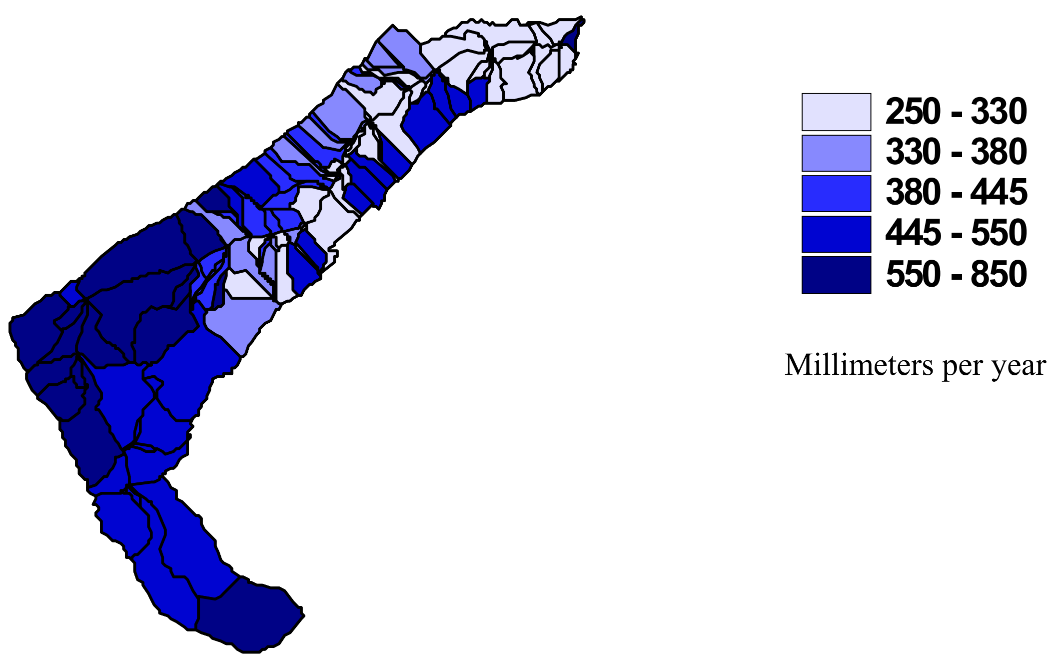

Figure 5-40. Average annual runoff simulated from AnnAGNPS for each cell on General Creek watershed.

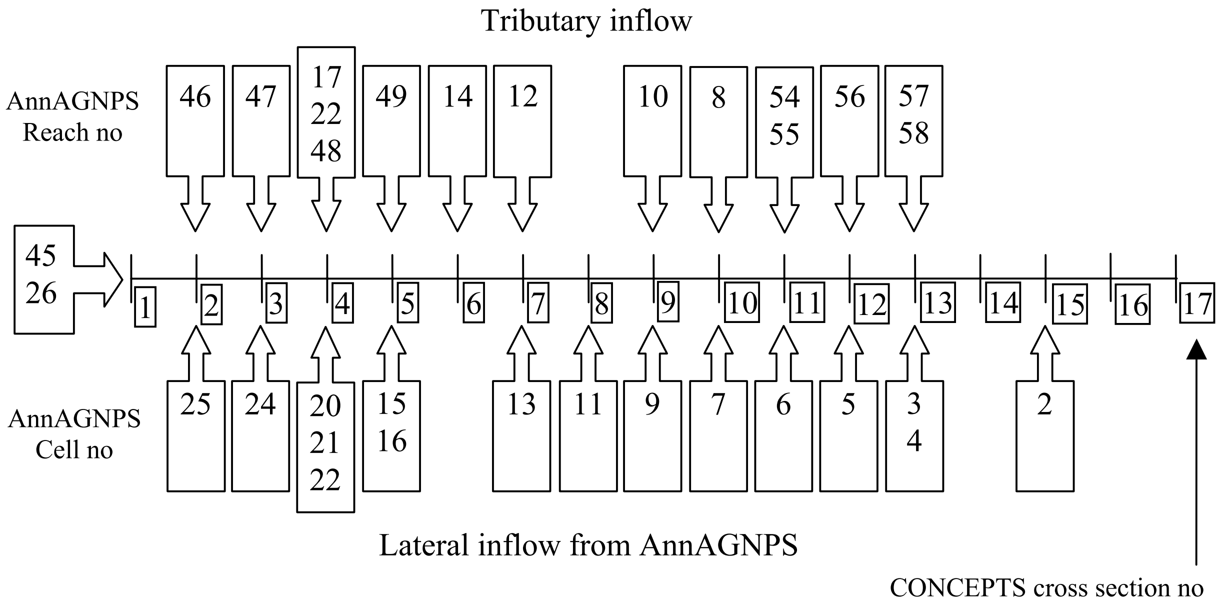

Figure 5-34. Linkage between AnnAGNPS reaches and cells (Figure 5-18) and CONCEPTS cross-sections for Ward Creek. (The last digit of the cell ID (a 2 or a 3) is omitted.)

5.4 <u>Model Validation and 50-Year Simulation</u>

5.4.1 General Creek

AnnAGNPS

Since AnnAGNPS provides the loadings into the main channel for eventual simulation by CONCEPTS, an evaluation of the capability of AnnAGNPS to reproduce the measured values of runoff, sediment, and peak rates helps in developing the input parameters needed by CONCEPTS in reproducing trends in watershed loadings. The location of an USGS gaging station (10336645) near the outlet of the watershed provided data needed for this comparison as well as any calibration that would be required. While AnnAGNPS can produce information at any point in the watershed, this gage was the only point available to compare simulated results with measured data. There were several techniques used to evaluate the performance of AnnAGNPS on the General Creek watershed by comparing annual and monthly runoff and sediment as well as an evaluation of the sources of the runoff and sediment within the watershed.

<u>Annual Runoff</u>. The annual runoff was simulated from 1976 to 2002 at station 10336645, while measured runoff was only available from 1981 to 2000 (Figure 5-35). The percentage of precipitation to runoff was very high, mainly because the snowmelt process occurred too early in the year. The comparison of measured and simulated runoff was good, but in some years the snowpack at higher elevations was not adequately reflected at the Tahoe City climate station resulting in underestimation of total runoff (Figures 5-35 and 5-36). Better climatic information would have improved the simulations of runoff.